WHAT IS CLAIMED IS:

1.   An abnormality detection system that detects abnormality in an oxygen sensor which outputs a current value corresponding to an oxygen concentration upon receipt of a voltage application, the abnormality detection system comprising:

a voltage application unit that applies a voltage to the oxygen sensor and switches polarity of the applied voltage between a positive voltage and a negative voltage; and

a controller that obtains an impedance of the oxygen sensor, and determines whether there is abnormality in the oxygen sensor based on a difference between the impedance of the oxygen sensor obtained when the positive voltage is applied to the oxygen sensor by the voltage application unit and the impedance of the oxygen sensor obtained when the negative voltage is applied to the oxygen sensor by the voltage application unit.

2.   The abnormality detection system according to claim 1, wherein the voltage application unit applies the negative voltage to the oxygen sensor when it is determined that a predetermined condition for detecting abnormality is established.

3.   The abnormality detection system according to claim 2, wherein the controller obtains the impedance of the oxygen sensor with a high frequency volts alternating current.

4.   The abnormality detection system according to claim 2, wherein the predetermined condition is established when a predetermined time period passes from stop of the fuel injection and no further fuel injection is performed.

5.   The abnormality detection system according to claim 1, wherein the controller obtains the impedance of the oxygen sensor with a high frequency volts alternating current.

6.   The abnormality detection system according to claim 1, wherein it is determined that there is the abnormality in the oxygen sensor when it is determined that the difference of the impedance of the oxygen sensor is equal to or less than a threshold value.

7.   The abnormality detection system according to claim 1, wherein the controller

determines whether there is abnormality in the oxygen sensor based on a difference between the impedance of the oxygen sensor obtained when the positive voltage is applied to the oxygen sensor and the impedance of the oxygen sensor obtained when the negative voltage is applied to the oxygen sensor after the application of the positive voltage.

8.   An abnormality detection method of detecting abnormality in an oxygen sensor for outputting a current value corresponding to an oxygen concentration upon receipt of a voltage application, the method comprising the steps of:

obtaining an impedance of the oxygen sensor by applying a negative voltage to the oxygen sensor; and

determining whether there is abnormality in the oxygen sensor based on a difference between the impedance of the oxygen sensor obtained when the negative voltage is applied to the oxygen sensor and the impedance oxygen sensor obtained when a positive voltage is applied to the oxygen sensor prior to the application of the negative voltage.

9.   The abnormality detection method according to claim 8, wherein the negative voltage is applied to the oxygen sensor when a predetermined condition for detecting abnormality is established.

10.   The abnormality detection method according to claim 9, wherein the impedance of the oxygen sensor is obtained with a high frequency volts alternating current.

11.   The abnormality detection method according to claim 9, wherein the predetermined condition is established when a predetermined time period passes from stop of the fuel injection and no further fuel injection is performed.

12.   The abnormality detection method according to claim 8, wherein the impedance of the oxygen sensor is obtained with a high frequency volts alternating current.

13.   The abnormality detection method according to claim 8, wherein it is determined that there is the abnormality in the oxygen sensor when it is determined that the difference of the impedance of the oxygen sensor is equal to or less than a threshold value.

14.   The abnormality detection method according to claim 8, wherein it is determined whether there is abnormality in the oxygen sensor based on a difference between the impedance of the oxygen sensor obtained when the positive voltage is applied to the oxygen sensor and the impedance of the oxygen sensor obtained when the negative voltage is applied to the oxygen sensor after the application of the positive voltage.

15.   An abnormality detection system that detects abnormality in an oxygen sensor which outputs a current value corresponding to an oxygen concentration upon receipt of a voltage application, the abnormality detection system comprising:

impedance obtaining means for obtaining an impedance of the oxygen sensor;

voltage application means for applying a voltage to the oxygen sensor and switches polarity of the applied voltage between a positive voltage and a negative voltage; and

determination means for determining whether there is abnormality in the oxygen sensor based on a difference between the impedance of the oxygen sensor obtained when the positive voltage is applied to the oxygen sensor by the voltage application means and the impedance of the oxygen sensor obtained when the negative voltage is applied to the oxygen sensor by the voltage application means.